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APPLICATION FOR LETTERS PATENT OF THE UNITED STATES

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TITLE OF INVENTION:

Multiple Position Support Structure

TO WHOM IT MAY CONCERN, THE FOLLOWING IS
A SPECIFICATION OF THE AFORESAID INVENTION

MULTIPLE POSITION SUPPORT STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to support systems. More specifically, it relates to a multiple position support system for diagnostic imaging. Aspects of the invention are particularly useful for repositioning a patient during an imaging diagnostic procedure.

2. Description of the Related Art

During a diagnostic procedure, it is necessary to provide a support structure, such as a table, for a patient undergoing the diagnostic procedure. Conventional tables are able to move the patient's body through a variety of positions throughout the diagnostic procedure. Once in a position for the diagnostic procedure, the table must be capable of holding the patient essentially motionless during the time needed to perform the diagnostic procedure. This is especially important during an imaging procedure. Movement of the patient and table combination during the imaging procedure could result in unusable images requiring the imaging procedure to be repeated. Other negative results from patient movement during the imaging procedure include additional time spent repeating the imaging procedure and/or unnecessary patient exposure to radiation from repeating the imaging procedure.

Additionally, the tables used in the imaging procedure should provide comfortable patient support since some imaging procedures require the patient to remain on the table for lengthy periods of time. Alternatively, tables may have additional supporting structures to hold a patient's body in a particular position on the table as dictated by the selected imaging procedure.

Conventional tables for imaging procedures are able to move into a position close to the floor for enabling the patient to easily move into position on its top surface. The table is also positionable to allow a patient to be transferred from a gurney, a stretcher, or a wheelchair. Once the patient is positioned atop

the table, an operator adjusts the height of the table for the selected imaging procedure. When the imaging procedure uses a multi-modality imaging device having different fields of view, the table, along with the patient, must be moved from the first field of view to the second field of view before completing the procedure. This may be especially problematic since platforms of the conventional tables have a limited angular range of movement that is generally less than about 90° while maintaining the platform substantially parallel to the base of the device.

Unnecessary movement of the table and patient is not desirable since it can introduce errors in the imaging procedure due to misalignment after the table is moved. Additional time is also required to move both the table and the patient between the fields of view. In some prior art tables, one or more persons are required to move the patient and table combination, which can add time to the imaging procedure and/or require additional personnel each time the patient needs to be moved for the imaging procedure. Alternately, having the patient get off the table before moving it and then having the patient reposition himself for the second field of view is an inefficient method of moving between the fields of view.

Examples of such support structures include U.S. Patent No. 4,449,262 to Jahsman et al. that relates generally to a lifting mechanism for a patient bed using pivotally connected support arms in a scissor arrangement and a motor coupled to the supporting arms. Another type of support structure is disclosed in U.S. Patent No. 5,953,776 to Sanders et al. that relates to a lifting apparatus for a patient table using a motor coupled to vertically extensible arms. U.S. Patent No. 6,565,112 to Hanson et al. discloses a chair that is capable of vertical movement using a plurality of connecting arms in a scissor arrangement. The aforementioned devices are directed toward raising and lowering the platform with the patient in a generally vertical plane.

Accordingly, a need exists for an improved multiple position support structure for use in diagnostic imaging procedures.

It is an object of the present invention to provide a multiple position support structure for use in diagnostic imaging procedures.

A further object of the present invention is to provide a multiple position support structure that is able to move through a plurality of positions.

Yet another object of the present invention is to provide a multiple position support structure that can be operated by a single person.

It is a further object of the present invention to provide a multiple position support structure that can move a patient from a first field of view to a second field of view during an imaging procedure by repositioning a portion of the multiple position support structure.

A further object of the present invention is to provide a multiple position support structure where the platform is movable between 0° and about 180° without repositioning the entire multiple position support structure.

SUMMARY OF THE INVENTION

A multiple position support structure according to the present invention is hereinafter disclosed. The multiple position support structure includes an elongated planar member, a base having a rotatable pedestal disposed thereon, and a linking assembly disposed therebetween. A plurality of connecting arms is included in the linking assembly where first ends of the connecting arms are pivotably coupled to the pedestal and flexible coupled to a bottom side of the planar member. The linking assembly is preferably configured as a four bar linkage that permits the planar member to pivotably move from a first position defining a first plane to a second position defining a second plane. During the movement from the first position to the second position, the planar member remains substantially parallel to the base and passes through an angle that is perpendicular to the base.

The pedestal is rotatable about a vertical axis for rotating the linking assembly and planar member attached thereto. A clutch assembly and lever combination may be included for manually rotating the pedestal and/or pivoting the planar member among the plurality of positions. A motor assembly including

a remote control device may be substituted for the clutch assembly and lever combination. The multiple position support structure may include a platform disposed on a top side of the planar member for supporting a patient during a diagnostic procedure.

A method of diagnostic imaging is also disclosed. The method includes providing a support device having a planar member and a plurality of connecting arms pivotably attached to the planar member. The connecting arm are configured and adapted to pass through an angle that is perpendicular to the planar member when the planar member moves from a first position defining a first plane to a second position defining a second plane. An operator positions a patient on the planar member on the support device and moves the planar member into the first position. Once the patient and planar member are in the first position, the operator performs a first diagnostic procedure on the patient. After completing the first diagnostic procedure, the operator moves the planar member to a second position where the operator performs a second diagnostic procedure on the patient. The plurality of connecting arms may be configured as a four bar linkage. The support device may also include a support assembly having a base and a pedestal rotatably mounted thereon. The connecting arms are pivotably connected to the pedestal. A clutch assembly and lever may be provided for rotating the pedestal. A motor assembly may be substituted for the clutch assembly and lever.

Further disclosed is a method for moving a patient from a first plane to a second plane by providing a support device having a planar member including a plurality of connecting arms pivotably attached to the planar member and configured to traverse an angle that is orthogonal to the planar member when moving from a first position defining a first plane to a second position defining a second plane. An operator positions the patient on the support device and moves the planar member to the first plane. The operator then moves the planar member to the second plane.

Additionally, a device for supporting a patient is disclosed that includes an elongated planar member, a support assembly having a base with a rotatable

pedestal disposed thereon, and a plurality of connecting arms located therebetween. Each connecting arm is pivotably attached to a bottom side of the planar member and pivotably attached to the pedestal. The plurality of connecting arms is configured for moving the planar member from a first position defining a first plane to a second position defining a second plane. A clutch assembly and lever may be provided for rotating the pedestal. A motor assembly may be substituted for the clutch assembly and lever. The connecting arms may be configured as a four bar linkage.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objects and advantages of the present invention may be more readily understood by one skilled in the art with reference being had to the following detailed description of preferred embodiments thereof, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a multiple position support system according to the present invention with a planar member in a first position and parallel to a base;

FIG. 2 is a perspective view of the multiple position support system of FIG. 1 with the planar member in a second position and parallel to the base;

FIG. 3 is a perspective view of the multiple position support system of FIGS. 1 and 2 with the planar member in a third position and parallel to the base; and

FIG. 4 is a perspective view of the multiple position support system of FIG. 3 with the planar member rotated orthogonally to the base.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Several embodiments of the present invention are hereby disclosed in the accompanying description in conjunction with the figures. Preferred embodiments of the present invention will now be described in detail with reference to the figures. With reference to FIGS. 1-4, there is illustrated a

multiple position support structure, or imaging table, in accordance with the present invention and generally designated by reference numeral 100.

The multiple position support structure 100 of the present invention includes a base 110, a pedestal 120, a linking assembly 130, and a planar member 140. The base 110 is an elongate planar structure with a top surface 112 and a bottom surface 114, where the base 110 is configured and adapted for placement on a horizontal surface 116 such as a floor. The base further includes a front-end portion 106 and a back-end portion 108.

The pedestal 120 is disposed on the top surface 112 of the base 110. The combination of the base 110 and the pedestal 120 provide structural support for the linking assembly 130. In one preferred embodiment, the pedestal 120 is configured and adapted for independent rotatable movement about a vertical axis-Y relative to the base 110. When configured and adapted for independent rotatable motion, the pedestal 120 may be attached to the base 110 by structure including a track (not shown) located on the top surface 112 of the base 110 and a corresponding set of wheels (not shown) disposed on the pedestal 120 as is known in the art. Other structures for rotatably coupling the pedestal 120 and the base 110 may be employed within the scope of the invention and include, but are not limited to, complementary gear arrangements in the pedestal 120 and the base 110 or an axle with bearings that rotatably connects the pedestal 120 and the base 110.

Motive force for rotating the pedestal 120 may be provided by an operator applying force to the planar member 140 or other convenient gripping structure to rotate the pedestal 120. When the operator supplies the motive force, it is preferred that the pedestal 120 include a clutch assembly 124 (shown in dashed lines) operably coupled to a lever 126. The clutch assembly 124 may be engaged or disengaged by the lever 126. In the engage position, the lever 126 engages the clutch assembly 124 that releases a braking mechanism located within the clutch assembly 124 and permits rotation of the pedestal 120. The operator may now rotate the pedestal 120 to the desired position. In the engaged position, the pedestal is rotatable from about 0° to about 360°. After the

pedestal 120 has been rotated to the desired position, the operator disengages the clutch assembly 124 by moving the lever 126 to the disengage position. By disengaging the clutch assembly 124, the pedestal 120 is inhibited from rotating due to the actuation of the brake mechanism located within the clutch assembly 124.

In an alternate embodiment, a motor assembly 122 (shown in dashed lines) is disposed within the pedestal 120 and is rotatably coupled to the base 110. In one arrangement, one portion of the motor assembly 122 is fixedly attached to the base 110 providing an anchor point for rotation while another portion of the motor assembly 122 is rotatably coupled to the pedestal using gears, pulleys and belts, or other coupling structures as known in the art. The motor assembly 122 rotates when power is applied to it and the rotational force of the motor assembly 122 is transferred to the pedestal 120 since one portion of the motor assembly 122 is anchored to the base 110. The motor assembly 122, and therefore the pedestal 120, is configured and adapted for clockwise and counter-clockwise rotation about the vertical axis-Y. Power sources for the motor assembly 122 include electric (both alternating and direct currents), pneumatic, or hydraulic sources. Alternatively, one portion of the motor assembly 122 is fixedly attached to the pedestal 120 and another portion of the motor assembly 122 is rotatably coupled to the base. This provides clockwise and counter-clockwise rotation about the vertical axis-Y by reversing the anchor and rotation points of the motor assembly 122. Similar coupling structures and power sources, as discussed hereinabove, are employable in this configuration. Either of the above-mentioned configurations may include a remote control device 128 that allows the operator to start and stop the rotation of the pedestal 120. The remote control device 128 may also include controls for varying the rate of rotation and selecting the direction of rotation.

Still referring to FIG. 1, the linking assembly 130 includes a plurality of elongated connecting arms 132 pivotably coupled to the pedestal 120. Although four connecting arms 132 are illustrated in FIG. 1 as a four bar linkage, the linking assembly 130 may include more or less than four connecting arms 132

while keeping within the scope and spirit of the present invention. A first end 132a of each of the plurality of connecting arms 132 is pivotably attached to the pedestal 120 at a pivot point 134, and each of the connecting arms 132 is pivotable through a range of about 10° to about 170°. Preferably, all of the connecting arms 132 will move in unison to provide a smooth and uniform motion of the linking assembly 130 as it pivots from one position to another position. A variety of structures or mechanisms may be provided for each pivot point 134. One example of such a structure includes wheel and axle combinations where the first end 132a of each connecting arm 132 is fixedly attached to the wheel and the wheel is fixedly attached to the axle. In the wheel and axle configuration, the axle traverses an outer wall of the pedestal, is positioned perpendicular to the horizontal axis-X, and is rotatable. Other structures or mechanisms known in the art may be adapted for pivotably coupling the connecting arm 132 to the pivot point 134.

In one preferred embodiment, the motor assembly 122 is further coupled to each of the connecting arms 132 through the corresponding pivot point 134 for positioning the linking assembly 130 within its angular range of movement. Using the wheel and axle structure described hereinabove as an example, the motor assembly 122 is rotatably coupled to each of the connecting arms 132 through the corresponding wheel and axle structure. The motor assembly 122 is rotatably coupled to the plurality of axles thereby imparting rotational force to all of the wheels simultaneously for pivoting the linking assembly 130 through its range of angular movement. The motor assembly 122 is operably coupled to the plurality of axles as discussed hereinabove.

Further included in the motor assembly 122 is a selector mechanism that is operable by the operator to select the mode of operation of the motor assembly 122. In a first selectable mode, the motor assembly 122 is operably coupled to the linking assembly 130 for pivoting it through its range of angular movement. In a second selectable mode, the motor assembly 122 is operably coupled to the base 110 and the pedestal 120 for rotating the pedestal 120 relative to the base 110. A third selectable mode is the lock mode where the

motor assembly 122 engages both the linking assembly 130, and the base 110 and pedestal 120 combination simultaneously. By engaging these structures, the motor assembly 122 inhibits undesired movement of these structures by employing the principle of dynamic braking and/or an internal braking mechanism. In one preferred embodiment, the remote control device 128 is adapted to select the desired mode of operation in addition to its other functions as previously described.

In embodiments not employing the motor assembly 122, the clutch assembly 124 and lever 126 combination are configured and adapted to lock or unlock the linking assembly 130. By moving the lever 126 into the engage position, the clutch assembly 124 is engaged permitting rotational movement of the pedestal 120 and pivoting movement of the linking assembly 130 simultaneously. In this configuration, the clutch assembly 124 is also connected to the pivot points 134, such as the wheel and axle combination discussed previously, such that engaging the clutch assembly 124 releases the internal braking mechanism that is operably connected to the axles, thereby permitting pivoting movement of the linking assembly 130. When the operator disengages the clutch assembly 124 by moving the lever 126 to the disengage position, the internal braking mechanism engages the axles and inhibits further pivoting movement of the linking assembly 130. Rotational movement of the pedestal 120 is controlled by the clutch assembly 124.

At a second end 132b of each connecting arm 132 is an articulated connector 136 for flexibly attaching the second end 132b to a bottom side 144 of the planar member 140 as shown in FIGS. 1-3. An elongated platform 146 may be positioned atop the planar member 140 as necessary for operational considerations. The platform 146 may include ergonomic support structure for the patient during the diagnostic procedure, structure for properly positioning the patient during the diagnostic procedure, or other structures necessitated by the selected diagnostic procedure. Preferably, the planar member 140 is flexibly attached to the linking assembly 130 that is, in turn, pivotably attached to the pedestal 120. By connecting the planar member 140 to the pedestal 120 with the

linking assembly 130, the combination of the flexible articulated connectors 136 and the pivotable pivot points 134 permit the planar member 140 to remain substantial parallel to the horizontal axis-X as the linking assembly 130 pivots through its range of angular movement. Essentially, as the linking assembly 130 is pivoted through its range of angular movement, the flexible articulated connectors 136 also flex in a corresponding manner allowing the planar member 140 to maintain a substantially parallel arrangement with the horizontal axis-X and the base 110. This advantageous configuration permits the planar member 140 to be moved from a first position, as illustrated in FIG. 1, to a second position, as illustrated in FIG. 2 where the first position, defining the first plane, and the second position, defining the second plane, are substantially parallel to each other and to the base 110, that defines the base plane.

In the first position, the planar member 140 supports and positions the patient in a first modality field of view 102 for the diagnostic procedure as shown in FIG. 1. When the planar member 140 and patient are moved into the second position (see FIG. 2), the patient is positioned in a second modality field of view 104 for the diagnostic procedure. Movement of the planar member 140 over the center of the pedestal 120 is described in detail hereinafter.

Another significant advantage of the present invention is that the planar member 140 may be moved from a first position (see FIG. 1) through a position where the connecting arms 132 are substantially orthogonal to the base plane and the horizontal axis-X to a second position (see FIG. 2). The combination of the linkage assembly 130, configured as a four bar linkage, the pivot points 134, and the articulated connectors 136 provide sufficient rigidity to support the patient on the planar member 140 and sufficient flexibility to maintain the parallel relationship between the planar member 140 and the horizontal axis-X as the planar member 140 moves from the first position to the second position. In a preferred embodiment, the first position of the planar member 140 and the second position of the planar member 140 are substantially identical in vertical displacement from the base 110.

Referring to FIG. 3, the multiple position support structure 100 of the present invention is shown in a patient loading position where the planar member 140 maintains its parallel relationship to the horizontal axis-X when positioned for receiving a patient. In the patient loading position, the planar member 140 has a vertical displacement from the base 110 that is less than either the first position (see FIG. 1) or the second position (see FIG. 2).

FIG. 4 illustrates the planar member 140 in a substantially perpendicular relationship to the horizontal axis-X and the base 110. The motor assembly 122 or clutch assembly 124 and lever 126 combination is employed to rotate the pedestal 120 relative to the base 110. Although the planar member 140 is shown in a substantially perpendicular relationship to the horizontal axis-X, other angular relationships are possible within the range of pedestal's rotation about the vertical axis-Y.

In use, the multiple position support structure 100 is lowered to the patient loading position by the operator (FIG. 3). Depending on the available space at the location of the multiple position support structure 100, the operator may rotate the pedestal 120 relative to the base 110 to facilitate patient access to the planar member 140 (FIG. 4). If the pedestal 120 has been rotated for patient access, once the patient is on the planar member 140, the operator rotates the pedestal 120, using the motor assembly 122 or the clutch assembly 124, such that the planar member 140 is substantially parallel to the base 110 and the horizontal axis-X. After the patient is situated on the planar member 140, the operator pivots the planar member 140 into the first position within the first modality field of view 102. When the patient and the planar member 140 are in the first position, the operator performs a first diagnostic procedure on the patient in the first modality field of view 102. The operator may manually pivot the planar member 140 to the first position using the clutch assembly 124 and lever 126. Alternately, the operator may use the motor assembly 122 and remote control device 128 to pivot the planar member 140 into the first position.

After the diagnostic procedure is completed in the first modality field of view 102, the operator repositions the planar member 140 into the second

position within the second modality field of view 104. During the pivoting of the planar member 140 from the first position to the second position, the planar member 140 traverses an angle that is substantially perpendicular to the horizontal axis-X and substantially parallel to the vertical axis-Y (i.e. "over the center movement"). Once the planar member 140 is in the second position within the second modality field of view 104, the operator performs a second diagnostic procedure on the patient in the second modality field of view 104. The operator pivots the planar member 140 from the first position to the second position using the clutch assembly 124 and lever, or the motor assembly 122.

The patient and planar member 140 are returned to the patient loading position after the second diagnostic procedure is completed using the clutch assembly 124 and lever 126, or the motor assembly 122 to lower the planar member 140. Depending on the room configuration, the operator may rotate the pedestal 120 to facilitate patient egress from the planar member 140. Once in the patient loading position, the patient dismounts from the planar member 140.

The described embodiments of the present invention are intended to be illustrative rather than restrictive, and are not intended to represent every embodiment of the present invention. Various modifications and variations can be made without departing from the spirit or scope of the invention as set forth in the following claims both literally and in equivalents recognized in law.